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"truly an anachronism as old Claude Duret of 1609"—Claude Duret, who told the story of a tree in Scotland, from which falling leaves striking water on one side were transformed into fishes and striking land on the other were turned into birds. Charles Bonnet (1720-1793), though not an evolutionist, is remarkable as the author of the term. Strange to say, it meant then not evolution but something else, the term abiogenesis corresponding more to the meaning of the modern idea. Of the great naturalists, Linnæus was important merely as the founder of the "School of Facts," of which Cuvier was later the leader. The merit of Buffon, who "may be called the naturalist founder of the modern form of the evolution theory," was his suggestiveness. "He may be said to have asked all the questions which were to be answered in the course of the succeeding century." In Erasmus Darwin much of interest is found. For example, "the first clear and definite statement of the theory of the transmission of acquired characters considered as one of the factors of evolution."

Chapters V and VI of the work are entitled, respectively, "From Lamarck to St. Hilaire" and "Darwin." "Lamarck (1744-1829), as the founder of the complete modern theory of Descent, is the most prominent figure between Aristotle and Darwin." Professor Osborn's discussion of his achievements is full and fair. Goethe, too, comes in for an appreciative estimate, but Treviranus, the author thinks, is overrated, not going beyond Buffon and virtually taking the position held much earlier by Goethe. Of Darwin nothing need be said here. The author closes with these words: "It is for the future to determine whether the predecessors of Darwin and Darwin himself, in the principle to which he gave a life of thought, have fully answered the old, old problem, or whether we shall look for still another Newton in our philosophy of Nature."

In Professor Osborn's work, we gain a very fair idea of the movement of the evolution idea and of its significance, and it may be cordially recommended to those who wish to obtain a preliminary survey of the subject. It is remarkably free from typographical errors¹ which is very important in such a work, and is printed on good paper in a fine, large type. It is to be hoped that the works which follow it will be as useful and interesting.

T. J. McC.

AMPHIOXUS AND THE ANCESTRY OF THE VERTEBRATES. By *Arthur Willey*, B. Sc.

With a Preface by Henry Fairfield Osborn. New York and London: Macmillan & Co. 1894. Pp., 316. Price, \$2.50.

The present treatise constitutes the second volume of the Columbia University Biological Series, opened by Professor Osborn's *History of the Evolution Idea*, and although of a technical and special nature, is, by the subject which it treats, of high general interest and importance. That subject is the ancestry of the vertebrates

¹On page 113 the author refers to a paper of Maupertuis on "The Conservation of Energy Doctrine." Maupertuis never considered that subject; what is meant is the principle of least action.

from the point of view of the anatomy and development of *Amphioxus lanceolatus*. This little animal, varying from two to three inches in length, is the actual living realisation of the ideal imaginary representative of the primitive vertebrate, almost identical with the archetypal form supposed by evolutionists. "It is interesting," says Mr. Willey, "as being one of the few animals that were not known to Aristotle, having been described and figured for the first time in 1778 by the German zoölogist Peter Simon Pallas." Its true nature, however, was not recognised until it was re-discovered in 1834 in the Mediterranean seas by the Italian naturalist, Gabriel Costa, who showed that it was a fish. The name of *Amphioxus* was first given to it by William Yarrell in 1836, Pallas having called it *Limax lanceolatus*, thinking it a species of slug. Yarrell first discovered the notochord of *Amphioxus* as a cartilaginous vertebral column. Finally, in 1841 three memoirs appeared independently on the anatomy of *Amphioxus*, which laid the foundation of our present knowledge. Their authors were John Goodsir of Edinburgh, Heinrich Rathke of Königsberg, and Johannes Müller of Berlin. The work of the last named author, universally recognised as the greatest physiologist of the nineteenth century, was a masterpiece. It was established by these researches that *Amphioxus* was allied to the Cyclostomata, but differed from them, according to Johannes Müller, to a greater extent than a fish differs from an Amphibian. It inhabits shallow, sandy shores, its food consisting almost entirely of microscopic plants and vegetable *débris*. Its extreme shyness to a bright and sudden light is remarkable, being "probably correlated with the presence of black pigment spots in the nerve-cord." It occurs in astonishing abundance in the extensive salt-water pools near Messina, less abundantly in more temperate regions, but is found in greater or less numbers in nearly all parts of the temperate and tropical world. Yet world-wide as this distribution is, there is only a single genus with some eight species. When we add to this the fact that it is a shore-dweller and not a roving pelagic animal, it is evident beyond dispute that we have in *Amphioxus* an immensely archaic form of vertebrate.

A few words on the anatomy of this remarkable creature will directly establish its significance. It has no specialised head, no skull, brain, or jaws; it is destitute alike of limbs, of a centralised heart, of a developed liver, kidneys, in short of most of the organs which usually belong to vertebrata. It has, however, a rudimentary backbone in the form of what is called the notochord. To be brief, it is almost as nearly allied to a worm as it is to a fish. Now what is permanent as a cartilaginous notochord in *Amphioxus* is transitory in the embryos of the higher vertebrates. In other respects, too, there is a correspondence between the early embryonic history of vertebrates and the permanent condition of *Amphioxus*. The link between the vertebrates and *Amphioxus* and between *Amphioxus* and the worms, as shown in *Balanoglossus*, an isolated type of this class, is almost perfect, forming a very strong piece of evidence for the derivation of the vertebrates from the worms. "For the present," says Mr. Willey, "we may conclude that the proximate ancestor of the vertebrates was a free-swimming animal intermediate in organisation between an

Ascidian tadpole and Amphioxus. . . . The ultimate or primordial ancestor of the Vertebrates would be a worm-like animal whose organisation was approximately on a level with that of the bilateral ancestors of the Echinoderms," or, to quote Professor Osborn, who writes the Preface to the work, "it stands as a persistent specialised but not degenerate type, perhaps not far from the true ancestral line of the Vertebrates."

Mr. Willey's work is exhaustive, at least it will appear so to the general reader ; but a glance at the bibliography appended to the work, containing six pages of reference in small print, will show that in fact it is only an introduction to this tremendous subject. "No single group," says Professor Osborn, referring to the Protochordates, "illustrates more beautifully the principles of transformism. . . . They alone [the Ascidians] give us a whole chapter in Darwinism." In fact no biological subject could be more fascinating. The problems presented are sketched in the Introduction. We shall mention only the problem of Dohrn, which is of more recent interest. "According to him," says Mr. Willey, "not only were the Vertebrates *not* descended from forms allied to the Ascidians and Amphioxus, but the latter were, by a process of almost infinite *degeneration*, derived or degenerated from the former. That the Ascidians are degenerate animals, to the extent that they have become adapted to a fixed habit of life, is of course obvious ; but that they have phylogenetically undergone the immeasurable degeneration which was postulated by Dohrn, is a view which is entirely unjustified by facts." The first two chapters are devoted to the anatomy of Amphioxus, the third to the development of Amphioxus, the fourth to a brief sketch of the structure and development of the typical Ascidians, and the fifth to a consideration of the more abstruse relationships of the lower Vertebrates or Protochordates. The work concludes with a series of considerations on the features of transition between the craniate vertebrates, the protochordates, and the invertebrates. With its notes, illustrations, full index, good press-work, and fine treatment of its subject, Mr. Willey's work upholds the reputation which the Columbia Biological Series has already won for high excellence.

T. J. McC.

THE RIDDLE OF THE UNIVERSE. Being an Attempt to Determine the First Principles of Metaphysic, Considered as an Inquiry Into the Conditions and Import of Consciousness. By *Edward Douglas Fawcett*. London : Edward Arnold. 1893. Pp., 440. Price, 14s.

"The object of this work is a Metaphysic which, stalking naked, but not 'ashamed, among current iconoclasms, shall proffer a definite though necessarily 'tentative, solution of the World-Riddle.'" This solution the author hopes to expand in a future series of works. The present volume which forms a sort of prelude to the promised system is divided into two parts. "In Part I is presented a 'critical survey of the great *landmarks* in the history of modern philosophy, with 'a *primary* reference to their bearing on *metaphysical* (as opposed to merely psycho-logical and other) inquiries. . . . Part II is constructive, a *development*, and, it is